NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

TREE/SHRUB ESTABLISHMENT

(Acre)

CODE 612

DEFINITION

Establishing woody plants by planting seedlings or cuttings, direct seeding, or natural regeneration.

PURPOSE

This practice may be applied as part of a conservation management system to support one or more of the following purposes:

- Establish woody plants for forest products
- Provide wildlife habitat
- Provide long-term erosion control
- Improve water quality
- Treat waste
- Reduce of air pollution
- Sequester carbon
- Conserve energy
- Enhance aesthetics

CONDITIONS WHERE PRACTICE APPLIES

On any area where woody plants can be grown.

CRITERIA

General Criteria Applicable to All Purposes

Species will be adapted to site conditions and suitable for the planned purpose(s).

Planting or seeding rates will be adequate to accomplish the planned purpose.

Planting dates, and care in handling and planting of the seed, cuttings or seedlings will ensure that planted materials have an acceptable rate of survival.

Only viable, high-quality and adapted planting stock or seed will be used.

Site preparation shall be sufficient for establishment and growth of selected species. See practice standard FOREST SITE PREPARATION (490).

Adequate seed or advanced reproduction needs to be present or provided for when using natural regeneration to establish a stand.

Timing, planting equipment and planting method will be appropriate for the site and soil conditions.

The planting will be protected from unacceptable adverse impacts from pests, wildlife, livestock damage, or fire.

Comply with applicable federal, state, and local laws and regulations during the installation, operation and maintenance of this practice. Appropriate cultural resources review will be conducted before beginning any tree planting practice.

Known or potentially invasive species will not be used.

Woody plants will be established without compromising the integrity of property lines, fences, utilities, roads, legal drains, easements or rights of way.

Where subsurface drains (tile lines) cross a tree/shrub planting, and where these drains will remain functional, sealed conduit will be installed through the planting and extend a minimum for 100 feet from rows of large trees (capable of reaching heights greater than 60 feet) and 75 feet from all other trees and shrubs. Trees and shrubs

will not be planted within 50 feet of either side of subsurface drains.

If black walnut is to be planted refer to Guide to Selection of Soil Suitable for Growing Black Walnut in Illinois in REFERENCES.

Additional Criteria For Providing Wildlife Habitat

Use several native species that best meet wildlife needs. See HEDGEROW PLANTING (422) for recommended list of woody plant species.

Additional Criteria for Providing Long-term Erosion Control

Plants or seed will be evenly distributed over the site. Equipment will be operated on the contour or across the slope. Apply mulches, plant residues contour planting or other appropriate erosion control measures (see conservation practice standards MULCHING, 484 and FOREST TRAILS AND LANDINGS, 655). Use non-competitive cover crops between planted rows (see conservation practice standard CONSERVATION COVER, 327). Competing vegetation will be controlled with a herbicide rather than tillage.

Additional Criteria for Improving Water Quality and Treating Waste

Use multiple native species, especially those that are deep rooted, in order to maximize nutrient uptake. If in a riparian area, use species adapted to local flooding.

CONSIDERATIONS

When underplanting, trees should be planted sufficiently in advance of overstory removal to ensure full establishment.

Priority will be given to plant materials that have been selected and tested in tree/shrub improvement programs.

Seed source of all plant materials should be within 200 miles north or south of the planting site.

Plans for landscape and beautification plantings should consider foliage color, season and color of flowering, and mature plant height.

Tree/shrub arrangement and spacing should allow for access lanes.

Evaluate residual chemical carryover prior to planting.

Consider using tube tree shelters to mark rows in row plantings. Use as many tree shelters as feasible, especially if rabbit or deer damage is likely. Place the shelters over the most vigorous seedlings and secure with a decay resistant stake.

For level planting sites of more than a few acres consider operating planting equipment in a circling pattern, spiraling inward from the outside to the center. An inward spiraling pattern eliminates the need to stop and turn at the ends of rows, saving time. A more natural appearance is also obtained since row direction is not readily apparent.

Direct seeding sites within 100 feet of tree or grass cover are subject to high seed predation by rodents, reducing chances for success. Consider using other stock types, doubling the seeding rate, reducing rodent populations or a combination of the above. A snap trap survey of rodent populations shortly before seeding the site will allow an opportunity to manage damaging populations before they eat or damage tree seed. See Illinois Direct Seeding Handbook for information on Wildlife Damage Management.

When direct seeding, increase the seeding rate as much as possible above the minimum with low cost or locally available woody seeds, which serve as a woody cover crop or nurse crop. Woody plants are usually less competitive than grasses or forbs and are the best companion crops for trees. Potential nurse crop species include the light seeded tree species (see **Species Selection**). Other potential trees and shrubs include hazelnut, redbud, sumac, dogwood, pawpaw, chokecherry, and plum (see Direct Seeding of Shrubs in REFERENCES). Limit the use of fast growing species such as ash, silver maple, sycamore, black cherry and walnut in plantations that include oak to avoid overtopping and suppressing the slower growing oaks.

Direct seeding by hand is usually not feasible for areas larger than approximately 5 acres. Many kinds of existing machinery can be adapted to plant tree seed. Much more efficient, precise and economical equipment has recently been developed, however, that will sow more seed at a faster rate, allowing up to 20 acres to be planted per day with a small crew. See Illinois Direct

Seeding Handbook for information on direct seeding equipment.

To reduce seed cost include small, light seed, such as ash, cherry and hackberry (see **Species Selection**). Use larger, more expensive seed, such as walnut and bur oak, more sparingly.

Test soils and/or consult soil survey report before planting to determine whether soil fertility, pH, or species mix need to be adjusted. Soil tests should indicate a minimum of 15 pounds of phosphorus and 150 pounds of potassium per acre. Some species, such as pin oak (pH < 6.8) and black walnut (high fertility), have very specific requirements.

Consider adding mycorrizal inoculate either as an amendment at the planting site or incorporated into water absorbing gel dip (synthetic polymer) for bare root seedlings.

PLANS AND SPECIFICATIONS

Specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, job sheets, technical notes, and narrative statements in the conservation plan, or other acceptable documentation.

Plans and specifications will include, as a minimum, the following: adapted tree species for the purposes outlined, size, origin and type of planting stock, time of planting, spacing, planting methods, cultural practices, and maintenance requirements.

The following table may be used as a guide in choosing suitable planting stock or seed:

Site	**Planting Stock**
Open Fields	1,2,3,5
Understocked Forestland	1,2,5
Landscaping	1,2,3,4,5
Environmental	1,2,3,5

1 = Bare root; 2 = Container grown; 3 = Cutting; 4 = Balled & burlapped; 5 = Direct seeding

All stock types: Discard weak, moldy or damaged material. Plant materials that have been dried, frozen, subjected to mold or high temperature will be assumed to be dead and will not be planted.

Bare root: Conifer seedlings will be no less than 3/32 inch in caliper at 1 inch above the root collar (nursery soil line). Hardwood seedlings will be not less than 7/32-inch caliper at 1 inch above the root collar. Conifer seedlings will be at least 6 inches in height above the root collar. Hardwood seedlings will be at least 12 inches in height above the root collar. All seedlings will have roots at least 8 inches long. Plant seedlings with well-branched, fibrous root systems. Determine depth of planting equipment and root prune only if necessary, to a length of no less than 8 inches, using a sharp tool. Never remove more than 25% of the root system.

Container grown: Containers must be at least 7 cubic inches in size. Minimums for air root pruned potted stock: height 3 feet, container size 1 gallon, caliper 3/8 inch.

Cuttings: Suitable species include cottonwood, hybrid poplar, willow, dogwood and elderberry. Use cuttings prepared during the dormant season from wood of the previous season's growth. At least two healthy buds will be included in the cutting. The minimum size of cuttings will be 3/8 inch in diameter and 8 inches long.

Balled and burlapped: Use stock that is at least 18 inches tall for shrubs and conifers and 48 inches for hardwood trees. Do not use plants with cracked or broken rootballs, root systems that are visible on the rootball surface, or roots that circle the trunk. Minimum rootball and caliper sizes will be: **Conifers:**

Tree Height	Minimum Diameter Ball
18-24"	10"
2-3'	12"
3-5'	14"
5-6'	20"

Hardwoods:

Tree Height	Minimum Diameter Ball	Caliper[1]
4-6'	12"	1/2"
6-8'	14"	3/4"
8-10'	16"	1"

[1]caliper (diameter) at 1 inch above root collar.

(Be advised that although ball and burlapped stock is usually the largest type of planting stock available it will probably not outperform other types of planting stock over time. Often other stock types will equal or surpass balled and burlapped stock within 5 to 10 years, at much lower initial cost.)

Direct seeding: Only undamaged, viable, mature seed will be used. Inspect by species at least 10 randomly selected seed per bushel. Crack or cut open seed and to be sure all seed is filled, moist, normal colored and not destroyed by insects. For more information on how to inspect seed see Seeds of Woody Plants of the United States or Seed Biology and Technology of Quercus (for oaks) or the Illinois Direct Seeding Handbook. Acorns may have up to one insect hole and ¼ of the nut damaged by insects and still be viable. If any non-viable seed is found the seeding rate will be increased by the percentage of non-viable seed.

Care of Planting Stock

Protect stock from desiccation during temporary storage and delivery to the planting site. Keep all types of planting stock, except the ones needed immediately for a supply during planting, stored in a cool environment (below 50 degrees F) out of direct sunlight and wind.

Bare root: Promptly examine in the shipping container and moisten packing material, if necessary. Seedling roots may be soaked in water for no more than 2 hours or coated with a water absorbing gel dip (synthetic polymer) immediately before planting to increase survival. If planting will be delayed for more than 5 days, keep seedlings in shipping container and place in cold storage at 35-40 degrees F. If cold storage is not feasible or available, seedlings will be heeled in. Dig a trench a little deeper than the root systems and spread roots against the back of the trench. Cover roots completely with soil, tamped to eliminate air spaces. Water as needed to keep roots moist but not wet.

Container grown: Keep in containers in a shady location and maintain soil moisture. Do not drop. Thoroughly water 2 days before planting to facilitate removal from containers.

Cuttings: If planting will be delayed, place in moist packing material and then in plastic bags and refrigerate at 35-40 degrees. Warm and soak cuttings for 5-10 days before planting. Make small slits in the bag, leave cuttings in the bag and immerse ¾ of their length in water. Place cuttings in shade at 50-70 degrees F. Cuttings are ready to plant when the buds start elongating, showing some bright green around the bud scales, and just before roots begin to grow. If weather prevents planting when cuttings are ready, cuttings can be held for weeks by placing them in cold storage at 35-40 degrees F.

Balled and burlapped: Keep the rootball moist by watering slowly from the top. Wet the foliage occasionally. Store temporarily (less than 2 weeks) by placing soil or mulch around the entire ball and keeping it moist.

Direct seeding: See Illinois Direct Seeding Handbook for seed collection sorting and handling techniques by species. If possible, seed should be planted as soon as it has been cleaned and sorted. If planting is delayed more than a few days seed will be placed in porous bags, such as onion bags, and in cold storage, no more than 50 degrees F and preferably 35-40 degrees F. All light seeded species (see **Species Selection**) as well as persimmon and Kentucky coffeetree will be kept dry. Heavy seeded species will be kept moist but not wet. Do not allow to mold. Acorns will be rehydrated by soaking in cold water for not less than 4 and not more than 24 hours as soon as possible after collection or delivery and not allowed to dry out. Do not allow seed to heat up. Avoid storing in large quantities unless well ventilated and refrigerated. Never leave tree seed in the sun. For further information by species see Seeds of Woody Plants of the United States or Seed Biology and Technology of Quercus (for oaks) or the Illinois Direct Seeding Handbook.

If light seeded species will be stored for more than a few weeks place is sealed containers at 35-40 degrees F. If heavy seeded species will be stored for more than a few weeks transfer to sealed plastic bags: 1.75 mil for white, chinkapin and swamp chestnut oak; 4 mil for all other species. Store at 35-40 degrees F. Inspect bags periodically and if no condensation is visible on the inside of bags rehydrate by soaking. Inspect seed, as described in the previous section, when removing from storage before planting. Acorns in the white oak group should be planted as soon as possible in fall, do not try to store more than 6 months. Other species can be stored under carefully controlled temperature and humidity for up to 3 years and planted whenever soil is unfrozen and moisture is adequate. If sprouting of seed begins seed can still be successfully planted but risk of dehydration is increased.

Planting Dates

Bare root seedlings: Do not plant into frozen or dry soil. Begin planting as soon as the ground can be worked and complete by the dates below (see Illinois Field Office Technical Guide, Section I, Climatic Data, for Plant Suitability Zones):

Plant Suitability Zone I: June 1
Plant Suitability Zone II: May 25
Plant Suitability Zone III: May 15

Plant as soon as possible after materials arrive, preferably the day of delivery. Plant cuttings within 2 days of collection or shipping arrival. Avoid planting on hot, windy days. A cool, cloudy day is preferred.

Container grown: Plant from September 1 until the ground freezes in the fall or winter. Planting may begin again in spring as soon the soil can be worked and continue until May 15. These dates apply to all Planting Zones in Illinois.

Cuttings: Plant between mid-April and June when soil temperature reaches 50 degrees F, or when corn is being planted locally. Soil must be moist.

Balled and burlapped: Plant whenever ground is not frozen and soil moisture is adequate. Water if needed.

Direct seeding: Seed may be planted whenever the ground is not frozen and soil moisture is adequate. Planting in July, August and early September, however, may result in lower survival due to high soil temperatures and potential for rapid loss of soil moisture.

Site Preparation

Based on cover present, follow guidelines in practice standard FOREST SITE PREPARATION (490).

Planting Methods

All stock types: Assure that tree planting is performed by trained and closely supervised personnel. Hand planting is well suited to small areas, plantings on steep terrain, or sites that are rough, rocky, or have scattered slash and logging debris. Machine planting is well suited to gentle terrain and well-prepared sites.

Bare root: Plant upright (within 20 degrees of vertical for hardwoods, 10 degrees for conifers) at same depth or slightly deeper than depth in nursery. Properly planted seedlings should resist gentle lifting pressure. Do not allow roots to be twisted or bent into a J or L shape. Inspect by digging up and replanting a sample of planted trees. Check for proper depth and adequate packing of soil around roots.

Container: Plant by hand or using an auger that is larger in diameter than the container. Handle plants by moving the container, not by grasping the stem. Remove plants from containers before placing in the ground. If plants are in paper pots, slit along each side or remove before placing in the ground. Place plants at the same depth as in the nursery and firmly pack soil around roots to eliminate air pockets. On wetland and floodplain sites the best results have been obtained when ridges or raised beds at least 12 inches high have been created and seedlings planted into these slightly raised sites.

Cuttings: Keep cuttings wet while planting. Plant in a vertical position with buds pointing up. Leave 1 or 2 good buds above ground, about 1 inch of the cutting exposed. If soil is loose cuttings may be pushed into soil by hand, otherwise make a hole with a dibble. Firm but do not pack the soil. Assure that bottom of cuttings will be deep enough to reach moist soil.

Balled and burlapped: Dig holes 1 ½ as big as the rootball. Handle plants by moving the rootball, not by grasping the stem. Remove any rope, wire, or plastic twine from the tree. Pull back burlap around trunk and fold once in the hole. Place plants at the same depth as in the nursery and firmly pack soil around roots to eliminate air pockets. Water if needed.

Direct seeding: Seed may be planted mechanically or by hand, in rows or broadcast. Depth of planting for heavy seeded species will be approximately 2 times the seed diameter, or 1 to 5 inches deep depending upon species. Plant all species at 2 inches or more if seed predation and/or low soil moisture are anticipated. Light seeded species will be sown on the surface of the soil. Heavy seed that is broadcast will be disked in and cultipacked or rolled.

Natural regeneration: In some instances it is not feasible or practical to attempt to establish a stand of trees by either planting or direct seeding in

either spring or fall. Natural regeneration may be used under any of the following conditions:

- Local reports or a site inspection indicate that the site is flooded, subject to swift currents, or too wet for planting equipment in both spring and fall of the typical year.
- The site is inaccessible to planting equipment (islands or other remote sites).
- The site is on the unprotected side of levees along major rivers (fourth order stream or greater)
- There are existing mature trees, preferably including at least 2 hard mast tree species, within 200 feet of the entire planting site.

Planting rates

All stock types: Plantation success is highly correlated with high numbers of seedlings or seed planted. The rates listed below are minimums. Exceeding these minimums will likely reduce the need for weed control, speed the establishment of forest cover and improve the ultimate timber value of the stand.

Direct seeding: Use the same rates for all intended products and purposes. Plant a minimum of 3,000 seed per acre of heavy seeded species (see **Species Selection**) if row planting; 4,800 if broadcast seeding. If there is not a source of light seeded woody plants within 500 feet of the planting site add another 1000 seed per acre of either light or heavy seeded species. See Illinois Direct Seeding Handbook, Appendix A-10 for seed per pound by species. To overcome predation by wildlife double the seeding rate for the first 100 feet beyond a forest or grassland edge.

The following chart shows row spacing and seed spacing combinations that will result in 3000 seed per acre:

Row Spacing (feet)	Seed Spacing (inches)
6	2.4
7	2.0
8	1.8
9	1.6
10	1.5
11	1.3
12	1.2
13	1.1
14	1.0
15	1.0
16	0.9
17	0.9
18	0.8

Container: Smaller container stock (less than 1 gallon) can be planted at the rates listed below for bare root and cuttings. Large (1 gallon or greater) container stock is best suited to sites that have a history of being wet or flooded in spring since they can be effectively planted in fall when bare root seedlings are less available and subject to frost heaving. Large container stock is capable of rapid height growth, allowing it to keep up with fast growing, light seeded bottomland tree species. Rapid early height growth is important also for establishing windbreaks. If natural regeneration is expected to fill in between container trees plant at 28 trees per acre (approximately 40' X 40'). Adequate fill in natural regeneration is likely to occur on frequently flooded sites with an upstream floodplain that is dominated by woody vegetation or where a mature forest stand is within 200 feet of the planting site. If the above conditions do not exist plant at least 50 trees per acre (approximately 30' X 30').

Balled and Burlapped: See *Energy Conservation, Snow Control and Beautification* below.

Wood Products

Bare root or cuttings: The following minimum planting rates, evenly distributed over the site, will be used for the following intended products by species:

Product	Plants/ac	Spacing (feet)
Sawtimber/veneer, hardwood	436	10 X 10

Sawtimber/veneer, conifer	681	8 X 8
Biofuels (biomass)	1210	6 X 6
Christmas trees	1210	6 X 6 or 5 X 8

Agroforestry

See specific practice standard, ALLEYCROPPING (311), WINDBREAK/SHELTERBELT ESTABLISHMENT (380), RIPARIAN FOREST BUFFER (391).

Wildlife Habitat and Watershed Protection

For trees use the same rates shown above for Wood Products. For shrubs use 1090 plants per acre, 5' X 8' spacing. For more information regarding direct seeding of shrubs see Direct Seeding of Shrubs in REFERENCES.

Erosion Control and Water Quality

Bare root and cuttings: Use the same rate as above for Wood Products, evenly distributed over the site.

Energy Conservation, Snow Control and Beautification

For energy conservation and snow control see WINDBREAK/SHELTERBELT ESTABLISHMENT (380). For beautification planting rates will vary according to the extent of the planting and individual site plans.

Species Selection

All stock types: Plantation success is highly correlated with increased species diversity. Plant as many different suitable species as possible. For shrub plantations, see practice standard HEDGEROW PLANTING (422) for recommended species.

Direct seeding: The following species have been successfully established using direct seeding:

Heavy seeded spp:	Light seeded spp
Black walnut	Ash
Oak	Maple
Hickory	Basswood
Pecan	Sycamore
Persimmon	Sweetgum
Kentucky coffeetree	Hackberry/Sugarberry
	Black cherry
	Tuliptree
	Bald cypress
	Tupelo

For all other kinds of planting stock refer to Illinois Field Office Technical Guide Section II, Conservation Tree/Shrub Groups and Forestland Interpretations, or the standard for the conservation practice being planned.

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance).

A weed-free area at least 2 feet in all directions from planted or seeded trees and/or shrubs will be maintained for at least the first 2 years after planting. Competing grass species will continue to be controlled in a 2-foot radius until woody plants are at least equal in height to competing grasses. Noxious weeds will be controlled. If mulches are to be used refer to practice standard MULCHES (484). If herbicides are to be applied read and follow all label directions.

Replanting will be required when survival after one growing season is less than 70% of plant materials other than seed. Direct seeded sites will be replanted if survival after 2 growing seasons is less than 500 seedlings per acre, including desirable natural regeneration. Replant to the minimum requirements above..

The trees and shrubs will be inspected periodically and protected from adverse impacts including insects, diseases or competing vegetation, fire and damage from livestock or wildlife.

Apply appropriate minerals according to a soil test to a minimum of 15 pounds per acre of phosphorus and 150 pounds per acre of potassium. Adjust pH only when human action has resulted in an unnatural pH.

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